

5.6. REFERENCES

- Anderson, J., J.M. Russell III, S. Solomon, and L.E. Deaver, Halogen Occultation Experiment confirmation of stratospheric chlorine decreases in accordance with the Montreal Protocol, *J. Geophys. Res.*, **105**, 4483-4490, 2000.
- Andrews, A.E., K.A. Boering, S.C. Wofsy, B.C. Daube, D.B. Jones, S. Alex, M. Loewenstein, J.R. Podolske, and S.E. Strahan, Empirical age spectra for the midlatitude lower stratosphere from in situ observations of CO₂: Quantitative evidence for a subtropical "barrier" to horizontal transport, *J. Geophys. Res.*, **106**, 10,257-10,274, 2001.
- Andrews, A.E., K.A. Boering, B.C. Daube, S.C. Wofsy, M. Loewenstein, H. Jost, J.R. Podolske, R.L. Herman, R.D. May, E.J. Moyer, J.W. Elkins, G.S. Dutton, D.F. Hurst, F.L. Moore, E.A. Ray, P.A. Romashkin, P.R. Wamsley, and S.E. Strahan, Mean ages of stratospheric air derived from in situ observations of CO₂, CH₄, and N₂O, *J. Geophys. Res.*, in press, 2002.
- Battle, M., M. Bender, T. Sowers, P.P. Tans, J.H. Butler, J.W. Elkins, J.T. Ellis, T. Conway, N. Zhang, P. Lang, and A.D. Clarke, Atmospheric gas concentrations over the past century measured in air from firn at the South Pole, *Nature*, **383**, 231-235, 1996.
- Bergamaschi, P., C.A.M. Brenninkmeijer, M. Hahn, T. Röckmann, D.H. Scharffe, P.J. Crutzen, N.F. Elansky, I.B. Belikov, N.B.A. Trivett, and D.E.J. Worthy, Isotope analysis based source identification for atmospheric CH₄ and CO sampled across Russia using the trans-Siberian railroad, *J. Geophys. Res.*, **103**, 8227-8235, 1998.
- Butler, J.H., Better budgets for methyl halides?, *Nature*, **403**, 260-261, 2000.
- Butler, J.H., S.A. Montzka, A.D. Clarke, J.M. Lobert, and J.W. Elkins, Growth and distribution of halons in the atmosphere, *J. Geophys. Res.*, **103**, 1503-1511, 1998.
- Butler, J.H., M. Battle, M. Bender, S.A. Montzka, A.D. Clarke, E.S. Saltzman, C. Sucher, J. Severinghaus, and J.W. Elkins, A twentieth century record of atmospheric halocarbons in polar firn air, *Nature*, **399**, 749-765, 1999.
- Crutzen, P.J., N.F. Elansky, M. Hahn, G.S. Golitsyn, C.A.M. Brenninkmeijer, D.H. Scharffe, I.B. Belikov, M. Maiss, P. Bergamaschi, T. Röckmann, A.M. Grisenko, and V.M. Sevostyanov, Trace gas measurements between Moscow and Vladivostok using the trans-Siberian railroad, *J. Atmos. Chem.*, **29**, 179-194, 1998.
- Daniel, J.S., S. Solomon, and D.L. Albritton, On the evaluation of halocarbon radiative forcing and global warming potentials, *J. Geophys. Res.*, **100**, 1271-1285, 1995.
- Daniel, J.S., S. Solomon, R.W. Portmann, and R.R. Garcia, Stratospheric ozone destruction: The importance of bromine relative to chlorine, *J. Geophys. Res.*, **104**, 23,871-23,880, 1999.
- Elkins, J.W., Trends of trace gases, total chlorine, and total bromine in the lower stratosphere from 1991 through 2000, *Eos Trans. AGU*, **81**, F88, 2000.
- Fahey, D.W., K.K. Kelly, G.V. Ferry, L.R. Poole, J.C. Wilson, D.M. Murphy, M. Loewenstein, and K.R. Chan, In situ measurements of total reactive nitrogen, total water, and aerosol in a polar stratospheric cloud in the Antarctic, *J. Geophys. Res.*, **94**, 11,299-11,315, 1989.
- Fahey, D.W., R.S. Gao, K.S. Carslaw, J. Kettleborough, P.J. Popp, M.J. Northway, J.C. Holecek, S.C. Ciciora, R.J. McLaughlin, T.L. Thompson, R.H. Winkler, D.G. Baumgardner, B. Gandrud, P.O. Wennberg, S. Dhaniyala, K. McKinney, T. Peter, R.J. Salawitch, T.P. Bui, J.W. Elkins, C.R. Webster, E.L. Atlas, H. Jost, J.C. Wilson, R.L. Herman, A. Kleinböhl, and M. von König, The detection of large HNO₃-containing particles in the winter Arctic stratosphere, *Science*, **291**, 1026-1031, 2001.
- Fraser, P.J., D.E. Oram, C.E. Reeves, S.A. Penkett, and A. McCulloch, Southern hemispheric halon trends (1978-1998) and global halon emissions, *J. Geophys. Res.*, **104**, 15,985-15,999, 1999.
- Gan, J., S.R. Yates, H.D. Ohr, and J.J. Sims, Production of methyl bromide by terrestrial higher plants, *Geophys. Res. Lett.*, **25**, 3595-3598, 1998.
- Gao, R.S., E.C. Richard, P.J. Popp, G.C. Toon, D.F. Hurst, P.A. Newman, J.C. Holecek, M.J. Northway, D.W. Fahey, M.Y. Danilin, B. Sen, K. Aikin, P.A. Romashkin, J.W. Elkins, C.R. Webster, S.M. Schauffler, J.B. Greenblatt, C.T. McElroy, L.R. Lait, T.P. Bui, and D. Baumgardner, Observational evidence for the role of denitrification in Arctic stratospheric ozone loss, *Geophys. Res. Lett.*, **28**, 2879-2882, 2001.
- Geller, L.S., J.W. Elkins, J.M. Lobert, A.D. Clarke, D.F. Hurst, J.H. Butler, and R.C. Myers, Tropospheric SF₆: Observed latitudinal distribution and trends, derived emissions, and interhemispheric exchange time, *Geophys. Res. Lett.*, **24**, 675-678, 1997.
- Greenblatt, J.B., H. Jost, M. Loewenstein, J.R. Podolske, T.P. Bui, D.F. Hurst, J.W. Elkins, R.L. Herman, C.R. Webster, S.M. Schauffler, E.A. Atlas, P.A. Newman, L.R. Lait, M. Müller, A. Engel, and U. Schmidt, Defining the polar vortex edge from an N₂O:potential temperature correlation, *J. Geophys. Res.*, in press, 2002.
- Grooss, J.-U., G. Günther, P. Konopka, R. Müller, D.S. McKenna, F. Stroh, B. Vogel, A. Engel, M. Müller, K. Hoppel, R. Bevilacqua, E. Richard, R.M. Stimpfle, C.R. Webster, J.W. Elkins, D.F. Hurst, and P.A. Romashkin, Simulation of ozone depletion in spring 2000 with the Chemical Lagrangian Model of the Stratosphere (CLaMS), *J. Geophys. Res.*, in press, 2002.
- Groszko, W., and R.M. Moore, Ocean-atmosphere exchange of methyl bromide: NW Atlantic and Pacific Ocean studies, *J. Geophys. Res.*, **103**, 16,737-16,741, 1998.
- Hall, B.D., J.W. Elkins, J.H. Butler, S.A. Montzka, T.M. Thompson, L. Del Negro, G.S. Dutton, D.F. Hurst, D.B. King, E.S. Kline, L. Lock, D. MacTaggart, D. Mondeel, F.L. Moore, J.D. Nance, E.A. Ray, and P.A. Romashkin, Halocarbons and other atmospheric trace species, in *Climate Monitoring and Diagnostics Laboratory Summary Report No. 25 1998-1999*, edited by R.C. Schnell, D.B. King, and R.M. Rosson, pp. 91-113, NOAA Oceanic and Atmos. Res., Boulder, CO, 2001.
- Hall, T.M., and R.A. Plumb, Age as a diagnostic of stratospheric transport, *J. Geophys. Res.*, **99**, 1059-1070, 1994.
- Herman, R.L., K. Drdla, J.R. Spackman, D.F. Hurst, C.R. Webster, J.W. Elkins, E.M. Weinstock, J.G. Anderson, B.W. Ganrud, G.C. Toon, M.R. Schoeberl, A.E. Andrews, S.C. Wofsy, H. Jost, E.L. Atlas, D.W. Fahey, and T.P. Bui, Hydration, dehydration, and the total hydrogen budget of the 1999-2000 winter Arctic stratosphere, *J. Geophys. Res.*, in press, 2002.
- Hurst, D.F., P.S. Bakwin, R.C. Meyers, and J.W. Elkins, Behavior of trace gas mixing ratios on a very tall tower in North Carolina, *J. Geophys. Res.*, **102**, 8825-8835, 1997.
- Hurst, D.F., G.S. Dutton, P.A. Romashkin, J.W. Elkins, R.L. Herman, E.J. Moyer, D.C. Scott, R.D. May, C.R. Webster, J. Grecu, M. Loewenstein, and J.R. Podolske, Comparison of in situ N₂O and CH₄ measurements in the upper troposphere and lower stratosphere during STRAT and POLARIS, *J. Geophys. Res.*, **105**, 19,811-19,822, 2000.
- Hurst, D.F., S.M. Schauffler, J.B. Greenblatt, H. Jost, R.L. Herman, J.W. Elkins, P.A. Romashkin, E.L. Atlas, S.G. Donnelly, J.R. Podolske, M. Loewenstein, C.R. Webster, G.J. Flesch, and D.C. Scott, The construction of a unified, high-resolution nitrous oxide data set for ER-2 flights during SOLVE, *J. Geophys. Res.*, in press, 2002.
- King, D.B., J.H. Butler, S.A. Montzka, S.A. Yvon-Lewis, and J.W. Elkins, Implications of methyl bromide supersaturations in the temperate North Atlantic Ocean, *J. Geophys. Res.*, **105**, 19,763-19,769, 2000.
- Kjellström, E., A three-dimensional global model study of carbonyl sulfide in the troposphere and the lower stratosphere, *J. Atmos. Chem.*, **29**, 151-177, 1998.

- Kurylo, M.J., J.M. Rodriguez, M.O. Andreae, E.L. Atlas, D.R. Blake, J.H. Butler, S. Lal, D.J. Lary, P.M. Midgley, S.A. Montzka, P.C. Novelli, C.E. Reeves, P.G. Simmonds, L.P. Steele, W.T. Sturges, R.F. Weiss, and Y. Yokouchi, Short-lived ozone-related compounds, in *Scientific Assessment of Ozone Depletion: 1998, Global Ozone Res. and Monit. Proj. Rep.* 44, pp. 2.1-2.56, World Meteorol. Org., Geneva, 1999.
- Levitus, S., Climatological atlas of the world ocean, *NOAA Prof. Pap.*, 13, U.S. Govt. Print. Off., Washington, DC, 1982.
- Libert, J.M., J.H. Butler, S.A. Montzka, L.S. Geller, R.C. Myers, and J.W. Elkins, A net sink for atmospheric CH₃Br in the East Pacific Ocean, *Science*, 267, 1002-1005, 1995.
- Libert, J.M., J.H. Butler, L.S. Geller, S.A. Yvon, S.A. Montzka, R.C. Myers, A.D. Clarke, and J.W. Elkins, BLAST94: Bromine Latitudinal Air/Sea Transect 1994: Report on oceanic measurements of methyl bromide and other compounds, *NOAA Tech. Memo. ERL CMDL-10*, 39 pp., NOAA Oceanic and Atmos. Res., Boulder, CO, 1996.
- Libert, J.M., S.A. Yvon-Lewis, J.H. Butler, S.A. Montzka, and R.C. Myers, Undersaturation of CH₃Br in the Southern Ocean, *Geophys. Res. Lett.*, 24, 171-172, 1997.
- Montzka, S.A., J.H. Butler, R.C. Myers, T.M. Thompson, T.H. Swanson, A.D. Clarke, L.T. Lock, and J.W. Elkins, Decline in the tropospheric abundance of halogen from halocarbons: Implications for stratospheric ozone depletion, *Science*, 272, 1318-1322, 1996.
- Montzka, S.A., J.H. Butler, J.W. Elkins, T.M. Thompson, A.D. Clarke, and L.T. Lock, Present and future trends in the atmospheric burden of ozone-depleting halogens, *Nature*, 398, 690-694, 1999.
- Montzka, S.A., C.M. Spivakovskiy, J.H. Butler, J.W. Elkins, L.T. Lock, and D.J. Mondeel, New observational constraints for atmospheric hydroxyl on global and hemispheric scales, *Science*, 288, 500-503, 2000.
- Moore, F.L., J.W. Elkins, E.A. Ray, G.S. Dutton, R.E. Dunn, D.W. Fahey, R.J. McLaughlin, T.L. Thompson, P.A. Romashkin, D.F. Hurst, and P.R. Wamsley, Balloonborne in situ gas chromatograph for measurements in the troposphere and stratosphere, *J. Geophys. Res.*, in press, 2002.
- Morgenstern, O., J.A. Pyle, A. Iwi, W.A. Norton, J.W. Elkins, D.F. Hurst, and P.A. Romashkin, On the diagnosis of mixing from tracer-tracer correlations, 2, Comparison of model and measurements, *J. Geophys. Res.*, in press, 2002.
- Morris, R.A., T.M. Miller, A.A. Viggiano, J.F. Paulson, S. Solomon, and G. Reid, Effects of electron and ion reactions on atmospheric lifetimes of fully fluorinated compounds, *J. Geophys. Res.*, 100, 1287-1294, 1995.
- Oberlander, E.A., C.A.M. Brenninkmeijer, P.J. Crutzen, N.F. Elansky, G.S. Golitsyn, I.G. Granberg, D.H. Scharffe, R. Hofmann, I.B. Belikov, H.G. Paretzke, and P.F.J. van Velthoven, Trace gas measurements along the trans-Siberian railroad: The TROICA 5 expedition, *J. Geophys. Res.*, in press, 2002.
- Plumb, R.A., D.W. Waugh, and M.P. Chipperfield, The effects of mixing on tracer relationships in the polar vortices, *J. Geophys. Res.*, 105, 10,047-10,062, 2000.
- Popp, P.J., M.J. Northway, J.C. Holecek, R.S. Gao, D.W. Fahey, J.W. Elkins, D.F. Hurst, P.A. Romashkin, G.C. Toon, B. Sen, S.M. Schauffler, R.J. Salawitch, C.R. Webster, R.L. Herman, H. Jost, T.P. Bui, P.A. Newman, and L.R. Lait, Severe and extensive denitrification in the 1999-2000 Arctic winter stratosphere, *Geophys. Res. Lett.*, 28, 2875-2878, 2001.
- Prinn, R.G., R. Zander, D.M. Cunnold, J.W. Elkins, A. Engel, P.J. Fraser, M.R. Gunson, M.K.W. Ko, E. Mahieu, P.M. Midgley, J.M. Russell III, C.M. Volk, and R.F. Weiss, Long-lived ozone-related compounds, in *Scientific Measurement of Ozone Depletion: 1998, Global Ozone Res. and Monit. Proj. Rep.* 44, pp. 1.1-1.54, World Meteorol. Org., Geneva, 1999.
- Prinn, R.G., J. Huang, R.F. Weiss, D.M. Cunnold, P.J. Fraser, P.G. Simmonds, A. McCulloch, C. Harth, P. Salameh, S. O'Doherty, R.H.J. Wang, L. Porter, and B.R. Miller, Evidence for substantial variations of atmospheric hydroxyl radicals in the past two decades, *Science*, 292, 1882-1888, 2001.
- Proffitt, M.H., and R.C. McLaughlin, Fast-response dual-beam UV-absorption ozone photometer suitable for use in stratospheric balloons, *Rev. Sci. Instrum.*, 54, 1719-1728, 1983.
- Ray, E.A., F.L. Moore, J.W. Elkins, D.F. Hurst, P.A. Romashkin, G.S. Dutton, and D.W. Fahey, Descent and mixing in the northern polar vortex from in situ tracer measurements, *J. Geophys. Res.*, in press, 2002.
- Redeker, K.R., N.-Y. Wang, J.C. Low, A. McMillan, S.C. Tyler, and R.J. Cicerone, Emissions of methyl halides and methane from rice paddies, *Science*, 290, 966-969, 2000.
- Rex, M., et al., Chemical depletion of Arctic ozone in winter 1999/2000, *J. Geophys. Res.*, in press, 2002.
- Rhew, R.C., B.R. Miller, and R.F. Weiss, Natural methyl bromide and methyl chloride emissions from coastal salt marshes, *Nature*, 403, 292-295, 2000.
- Rhew, R.C., B.R. Miller, M.K. Vollmer, and R.F. Weiss, Shrubland fluxes of methyl bromide and methyl chloride, *J. Geophys. Res.*, 106, 20,875-20,882, 2001.
- Richard, E.C., K. Aikin, A. Andrews, B.C. Daube, C. Gerbig, S.C. Wofsy, P.A. Romashkin, D.F. Hurst, J.W. Elkins, E.A. Ray, F.L. Moore, T. Deschler, and G.C. Toon, Severe chemical ozone loss inside the Arctic polar vortex during winter 1999-2000 inferred from in situ airborne measurements, *Geophys. Res. Lett.*, 28, 2197-2200, 2001.
- Romashkin, P.A., D.F. Hurst, J.W. Elkins, G.S. Dutton, and P.R. Wamsley, Effect of the tropospheric trend on the stratospheric tracer-tracer correlations: Methyl chloroform, *J. Geophys. Res.*, 104, 26,643-26,652, 1999.
- Romashkin, P.A., D.F. Hurst, J.W. Elkins, G.S. Dutton, D.W. Fahey, R.E. Dunn, F.L. Moore, R.C. Myers, and B.D. Hall, In situ measurements of long-lived trace gases in the lower stratosphere by gas chromatography, *J. Atmos. Oceanic Technol.*, 18, 1195-1204, 2001.
- Salawitch, R.J., J.J. Margitan, B. Sen, G.C. Toon, G.B. Osterman, M. Rex, J.W. Elkins, E.A. Ray, F.L. Moore, D.F. Hurst, P.A. Romashkin, R.M. Bevilacqua, K. Hoppel, E.C. Richard, and T.P. Bui, Chemical loss of ozone during the Arctic winter of 1999-2000: An analysis based on balloon-borne observations, *J. Geophys. Res.*, in press, 2002.
- Schauffler, S.M., E.L. Atlas, D.R. Blake, F. Flocke, R.A. Lueb, J.M. Lee-Taylor, V. Stroud, and W. Travnicek, Distributions of brominated organic compounds in the troposphere and lower stratosphere, *J. Geophys. Res.*, 104, 21,513-21,535, 1999.
- Schauffler, S.M., E.L. Atlas, S.G. Donnelly, A.E. Andrews, S.A. Montzka, J.W. Elkins, D.F. Hurst, P.A. Romashkin, and V. Stroud, Chlorine budget and partitioning during SOLVE, *J. Geophys. Res.*, in press, 2002.
- Schnell, R.C., D.B. King, and R.M. Rosson (Eds.), *Climate Monitoring and Diagnostics Laboratory Summary Report No. 25 1998-1999*, 154 pp., NOAA Oceanic and Atmos. Res., Boulder, CO, 2001.
- Severinghaus, J.P., A. Grachev, and M. Battle, Thermal fractionation of air in polar firn by seasonal temperature gradients, *Geochem. Geophys. Geosyst.*, 2, paper number 2000GC000146 (electronic journal), 2001.
- Solomon, S., D. Wuebbles, I. Isaksen, J. Kiehl, M. Lal, P. Simon, and N.-D. Sze, Ozone depletion potentials, global warming potentials, and future chlorine/bromine loading, in *Scientific Assessment of Ozone Depletion: 1994, Global Ozone Res. and Monit. Proj. Rep.* 37, pp. 13.1-13.36, World Meteorol. Org., Geneva, 1995.
- Sturges, W.T., D.E. Oram, L.J. Carpenter, S.A. Penkett, and A. Engel, Bromoform as a source of stratospheric bromine, *Geophys. Res. Lett.*, 27, 2081-2084, 2000.
- Tans, P.P., P.S. Bakwin, L. Bruhwiler, T.J. Conway, E.J. Drugokencky, D.W. Guenther, D.R. Kitzis, P.M. Lang, K.A. Masarie, J.B. Miller, P.C. Novelli, K.W. Thoning, M. Trudeau,

- B.H. Vaughn, J.W.C. White, and C. Zhao, Carbon cycle, in *Climate Monitoring and Diagnostics Laboratory Summary Report No. 25 1998-1999*, edited by R.C. Schnell, D.B. King, and R.M. Rosson, pp. 24-46, NOAA Oceanic and Atmos. Res., Boulder, CO, 2001.
- UNEP (United Nations Environmental Programme), *Montreal Protocol on Substances that Deplete the Ozone Layer: Final Act*, 15 pp., New York, 1987.
- Varner, R.K., P.M. Crill, and R.W. Talbot, An estimate of the uptake of atmospheric methyl bromide by agricultural soils, *Geophys. Res. Lett.*, 26, 727-730, 1999.
- Volk, C.M., J.W. Elkins, D.W. Fahey, G.S. Dutton, J.M. Gilligan, M. Loewenstein, J.R. Podolske, K.R. Chan, and M.R. Gunson, Evaluation of source gas lifetimes from stratospheric observations, *J. Geophys. Res.*, 102, 25,543-25,564, 1997.
- Wamsley, P.R., J.W. Elkins, D.W. Fahey, G.S. Dutton, C.M. Volk, R.C. Myers, S.A. Montzka, J.H. Butler, A.D. Clarke, P.J. Fraser, L.P. Steele, M.P. Lucarelli, E.L. Atlas, S.M. Schauffler, D.R. Blake, F.S. Rowland, W.T. Sturges, J.M. Lee, S.A. Penkett, A. Engel, R.M. Stimpfle, K.R. Chan, D.K. Weisenstein, M.K.W. Ko, and R.J. Salawitch, Distribution of halon-1211 in the upper troposphere and lower stratosphere and the 1994 total bromine budget, *J. Geophys. Res.*, 103, 1513-1526, 1998.
- Woodbridge, E.L., J.W. Elkins, D.W. Fahey, L.E. Heidt, S. Solomon, T.J. Baring, T.M. Gilpin, W.H. Pollock, S.M. Schauffler, E.L. Atlas, M. Loewenstein, J.R. Podolske, C.R. Webster, R.D. May, J.M. Gilligan, S.A. Montzka, K.A. Boering, and R.J. Salawitch, Estimates of total organic and inorganic chlorine in the lower stratosphere from in situ and flask measurements, *J. Geophys. Res.*, 100, 3057-3064, 1995.